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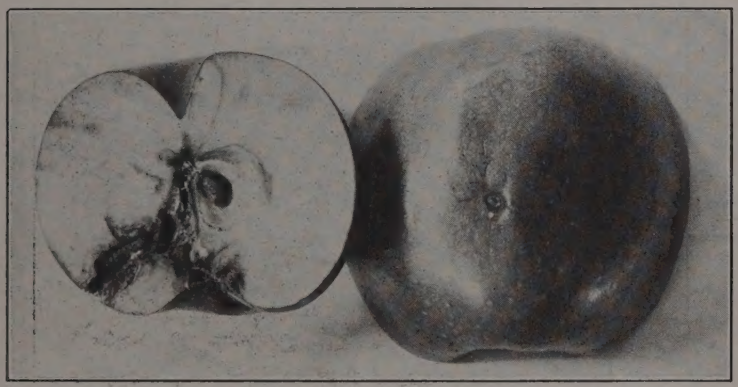
(REVISED)

SPRAYING FRUIT IN KENTUCKY



CODLING MOTH INJURY

a. First brood larvae which entered thru the calyx soon after blossoming. b. Second brood side sting. Larvae entered side but were killed by arsenical sprays in July.

Lexington, Ky.
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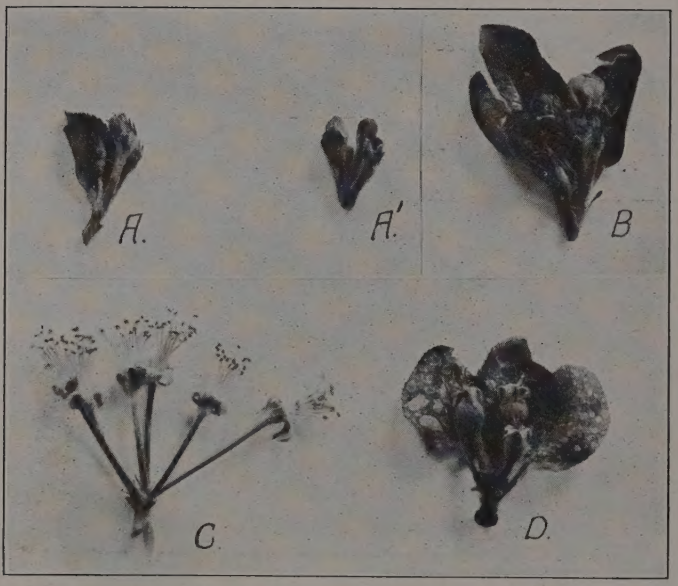

Fig. 1. A and A.[1] Pre-pink stage for scab control. (See note 2, page 7). The center bud shows pink but the cluster has not divided. B. Pink or Cluster Bud spray for scab control. Apply spray No. 2, C, D. Calyx or Petal Fall stage for codling moth control. Apply spray No. 3. In the average year there are about 5 to 8 days between conditions C. and D.

EXTENSION CIRCULAR NO. 176

(Revised)

SPRAYING FRUIT IN KENTUCKY

By W. W. MAGILL and A. J. OLNEY*

Successful orchardists now consider an efficient spray program a necessity. All sprays should be applied in a systematic manner. For successful results it is necessary to (1) use the correct material, (2) apply at the proper time and (3) apply very thoroly.

The spray schedules in this publication are arranged to meet average conditions. For the best results in commercial orchards, it is often desirable to make more frequent applications than are recommended in these pages.

Many commercial orchards have suffered in recent years from San Jose scale, and growers have been eager to learn of spray materials which would have greater killing efficiency than the ordinary lime-sulfur solution.

Some have used for this purpose the oil preparations known as "miscible oils" successfully. Others have used effectively the lubricating oil emulsion known as government oil emulsion, which is on sale by dealers in most commercial apple growing districts in prepared form ready for dilution. Oil emulsions should be freshly prepared each season, and should not be allowed to freeze as this may cause a separation of the oil, and result in injury to the trees. These sprays should be applied on clear mild days with temperatures above 40 degrees Fahrenheit, when there is no danger of freezing temperatures for several hours following.

In orchards practically free from scale, and particularly for peach orchards, the standard liquid lime-sulfur can be recommended.

*Acknowledgments are due to the State Horticultural Society, commercial growers thruout the state, the plant pathologist and entomologist of the Kentucky Agricultural Experiment Station and others for their valuable suggestions in preparing the circular.

Codling Moth. The adult moth deposits eggs on young foliage and blossoms. The eggs hatch in 5 to 10 days and the larvae enter the young apples, usually thru the calyx (see title page). The larvae become fullgrown in from 4 to 6 weeks and leave the apple to find a hiding place where they spin their cocoons, pupate, and emerge as adult moths about 2 weeks later. As soon as this second brood of moths appear they begin laying eggs on the young apples and foliage. These eggs hatch and the young worms enter the apples mostly thru the side (as b in cut on title page). Unless poisoned by late spraying, the worms feed in the apple, becoming full grown near harvest time, at which time they leave the apple, find a hiding place and hibernate. A part of the second brood sometimes completes its development early enough to produce a third brood in September, causing considerable side sting injury.

Concerning dry lime-sulfur, orchard experiments and laboratory tests in Kentucky and elsewhere in this latitude, have not yielded results to convince this Station of its full efficacy when used at the strengths recommended by the manufacturers.

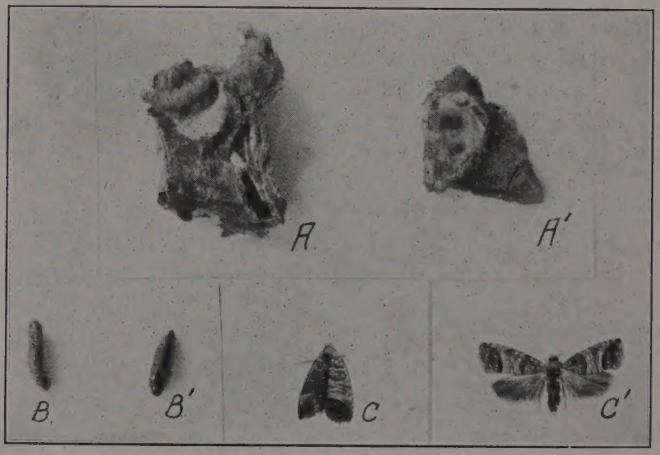

Fig. 2. Life Cycle of Codling Moth (natural size). A, A¹ Larvae hibernating under loose bark of tree. B. Larva changed to pupa in early spring about blossom time. B'. Empty pupa case. C. Adult codling moth, wings in natural position. C'. Wings spread. Apply spray No. 3 (See Fig. 1, C and D.)

If used as a substitute for standard liquid lime-sulfur for the dormant spray in Kentucky, probably nearly or quite twice the 12 or 15 lbs. usually recommended per barrel will be needed.

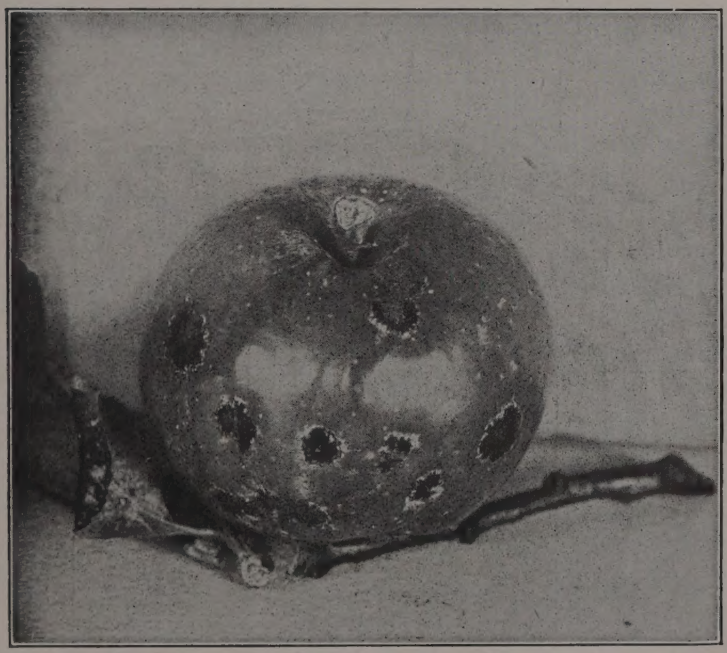

Fig. 3. Apple Scab. The Delicious, Winesap, Stayman, and Black Twig varieties are especially susceptible. Apply apple spray No. 2.

SPRAY SCHEDULE FOR APPLES.

SPRAY FOR	TIME TO APPLY	WHAT TO USE (Use one of the formulas)
1. San Jose Scale	Dormant season; fall of year after leaves have dropped, mild winter weather, or in spring before buds open.	(a) Standard lime-sulfur testing 32 degrees, 6 gals. Add water to make 50 gals. (b) Lubricating oil emulsion (government formula) 1½ gals. Add water to make 50 gals. (c) Commercial miscible oils or oil emulsions diluted according to the manufacturer's recommendations.
*2. Apple scab See Fig. 1, A, B.	Just before blossoms open, when the flower buds are showing pink.	(a) Lime-sulfur, 32 degrees, 1 gal. to 50 gals. water or (b) Dry lime-sulfur, 4 lbs. to 50 gals. water and 1½ lbs. arsenate of lead. If aphis be present, add ½ pt. 40% nicotine sulfate to 50 gals.
*3. Apple worm (codling moth), scab, bud moth, curculio. Fig. 1, C. D.	When three-fourths of blossoms have fallen.	(a) Lime-sulfur 1 gal. to 50 gals. or (b) Dry lime-sulfur, 4 lbs. to 50 gals. water and 1½ lbs. arsenate of lead.
4. Codling moth, scab, blotch	Two weeks after Spray No. 3	Bordeaux mixture 2-4-50 and 1½ lbs. arsenate of lead.
5. Blotch, scab, codling moth, rots	Two weeks after Spray No. 4	Same as Spray No. 4.
*6. Blotch, rots, codling moth, sooty blotch	Two weeks after Spray No. 5	Same as No. 5.
7. Codling moth, blotch, rots, bitter rot	About one month after Spray No. 6	Same as No. 5.

NOTES ON APPLE SPRAYING.

1. Where arsenate of lead is mentioned, the reference is made to the powdered form. Where paste is used, double the amount.

2. With varieties such as Delicious, Winesap or Stayman, which are especially susceptible to apple scab, some growers add a pre-pink spray to the schedule, making this application from three to five days before Spray No. 2, using same material as Spray No. 2.

3. When lime-sulfur is used for spraying in Kentucky, most commercial growers are buying it in the liquid form.

Fig. 4. Apple Blotch. Too late for control. Apply apple sprays Nos. 5, 6 and 7.

4. Owners of farm orchards and amateur growers may not see fit to apply the regular seven or more sprays. Probably the three most important sprays are Nos. 2, 3 and 6. Note they are marked with a (*). If only one spray is applied, use No. 3 to control the worms.

5. There is a tendency during the last two years to decrease the amount of bluestone in the Bordeaux. Some growers have obtained satisfactory results using a 1-4-50 formula. This is especially true with tender skinned varieties, such as the Grimes and Jonathan.

6. Lime-sulfur (summer strength) may be used in sprays Nos. 4, 5, 6 and 7 in place of Bordeaux on varieties which are not very susceptible to blotch, such as Winesap, Stayman, Delicious, Grimes.

7. "Two weeks later" should be interpreted to mean two weeks from the time the grower begins to make the application, rather than from the time the spray is finished.

8. In diluting stock of "government oil emulsion," the water used should be soft. If only hard water is available, add ¼ lb. of copper sulfate and ¼ lb. of lime to each 50 gals. of diluted mixture, as in making Bordeaux.

9. BORDEAUX MIXTURES: 2-4-50. Preparation of one barrel (50 gals.).

Dissolve 2 lbs. of bluestone (copper sulfate) in a wooden or Porcelean bucket of hot water, by suspending the bluestone in a cloth sack so it will hang two or three inches into the water.

Slake 4 lbs. of good stone lime, dilute and strain it into the spray tank or barrel and add 25 or 30 gals. of water. Dilute the bluestone solution with 8 or 10 gals. of water and add it to the lime water, stirring well as this is done, finally adding water sufficient to make 50 gals. in all. Apply at once. If good stone lime is not available, substitute 6 lbs. of a good grade of hydrated lime.

If much spraying is to be done, it is often more convenient to make up in advance separate stock solutions of both bluestone and lime at the rate of one pound to each gallon of water. If these stock solutions are kept covered to prevent evaporation, they can be kept for weeks ready for quick dilution and mixing as needed.

Bordeaux mixture should always be used when fresh.

SPRAY SCHEDULE FOR PEACHES.

SPRAY FOR	TIME TO APPLY	WHAT TO USE
1. San Jose scale; leaf curl	Dormant season. See note below	Lime-sulfur 6 gals. Add water to make 50 gals. (The various oil preparations will not control leaf curl.) Where scale is spreading use an oil spray also, for its control.
2. Curculio	1 to 4 days after blossoms fall	1 lb. arsenate of lead, 4 lbs. hydrated lime, 50 gals. water.
3. Curculio	Ten days after blossoms fall, when the shucks are being pushed off by young fruit	1 lb. arsenate of lead, 4 lbs. hydrated lime, 50 gals water.
4. Scab, brown rot, curculio	A month after blossoms fall	Self-boiled lime-sulfur 8-8-50 or sulfur-lime dry mix 8-4-½-50 and 1 lb. arsenate of lead.
5. Brown rot	A month before fruit is due to ripen	Self-boiled lime-sulfur 8-8-50 or sulfur lime dry mix 8-4-½-50.
6. Brown rot	In damp weather. Two weeks before fruit is to ripen	Same as Spray No. 4.

Note.—During the past 2 years many commercial peach growers in Kentucky and adjoining states have substituted a combination oil and Bordeaux mixture, for the lime-sulfur solution, for the dormant spray on peaches. It is used at the following dilution: Standard 6-6-100 Bordeaux mixture prepared in the usual manner, then with the agitator running add 3 gallons of government oil emulsion to the 100 gallons.

Fig. 5. Peach Leaf Curl. Dormant spray. Apply peach spray No. 1.

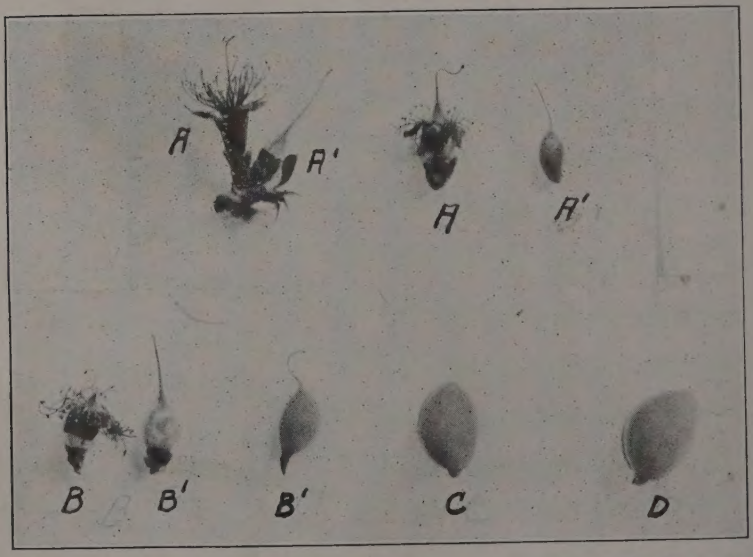

Fig. 6. A and A¹. 1 to 3 days after blossoms have fallen. Apply peach spray No. 2, for curculio. B and B'. 5 to 10 days after blossoms have fallen, as the shucks are being pushed off. Apply peach spray No. 3, for curculio. C and D. Too late for good curculio control.

NOTES.

1. Dry lime-sulfur, liquid lime-sulfur, or Bordeaux should NEVER be applied to the peach orchard during the summer.

2. For spray No. 2 some growers add the fungicide to the solution for additional control of brown rot.

3. On account of not being able to purchase a high grade of active lump lime for making self-boiled lime-sulfur, the "dry mix sulfur lime" is being much used. This can be prepared at home or purchased from commercial firms. It is made from 8 lbs. sulfur, 4 lbs. hydrated lime, and ½ lb. calcium caseinate (frequently sold under such trade names as Kayso, Spreado, etc.). This is thoroly mixed in the dry form, and used at the rate 12½ lbs. to 50 gals. of water. First add a small quantity of water gradually to the powder while stirring, until it becomes a paste, then dilute to make 50 gals. of spray mixture.

4. Preparation of SELF-BOILED LIME-SULFUR 8-8-50.

Slake 8 lbs. of the best stone or lump lime in a barrel or tight box. Use hot water when available, but only enough to start slaking.

When slaking begins add 8 lbs. of flowers of sulfur (previously mixed to a paste with a small quantity of water) to the slaking lime, stirring constantly. Continue to add water in small quantities, sufficient to keep the lime in a soft, pasty condition.

As soon as the slaking is over (usually within 15 minutes) add sufficient cold water to cool the mixture and stop the cooking of the sulfur. Stir vigorously and strain into spray barrel or tank, adding water to make 50 gals. of spray material.

If required, larger quantities may be made up at one time in the same proportion, as 32-32-200.

SPRAY SCHEDULE FOR PEARS.

Use apple sprays Nos. 1, 2, 3 and 5.

SPRAY SCHEDULE FOR SOUR CHERRIES.

Use apple sprays Nos. 1, 2 and 3.

NOTES.

1. Scale insects seldom attack sour cherries and if none are present, spray No. 1 may be omitted.

2. If serious infestation of leaf spot occurs, it may be controlled by applying apple sprays Nos. 4, 5 and 6, using Bordeaux but omitting the arsenate of lead.

SPRAY SCHEDULE FOR PLUMS.

Use same schedule as for peaches.

SPRAY SCHEDULE FOR GRAPES.

SPRAY FOR	TIME TO APPLY	WHAT TO USE
1. Grape berry moth, black rot, mildew	Just before blossoms appear	2-4-50 Bordeaux, 1½ lbs. arsenate of lead.
2. Grape berry moth, black rot, mildew	As soon as bloom falls	Same as Spray No. 1.
3. Black rot, mildew, grape root worm	Two weeks after Spray No. 2	Same as Spray No. 1.
4. Black rot	Two weeks after Spray No. 3	Same as Spray No. 1.

NOTE: If the rot is very bad, later sprays of Bordeaux may be necessary.

DILUTION OF LIME-SULFUR.

Lime-sulfur solution should always be tested and diluted according to the Baume test. The standard strength of lime-sulfur solution distributed by the leading manufacturers is 32° Baume. When the solution is kept for some time, especially if the container is not tight, it gradually loses strength, hence the importance of testing before use.

The hydrometer is an important part of the spray equipment. It is a glass instrument resembling a thermometer, used to measure density of liquids. Usually it is graduated with two scales, specific gravity and the Baume scale. A hydrometer and testing cylinder can be purchased from firms dealing in spray materials.

Directions for use: Fill the glass cylinder with the clear concentrated lime-sulfur solution. Place the hydrometer in the cylinder and read the Baume scale at the surface of the liquid. Dilute according to the table below.

LIME-SULFUR DILUTION TABLE

WHEN HYDROMETER READS		Use the following amounts lime-sulfur to make 50 gals of dormant spray for scale control. Should test about 5 degrees Baume.	Use the following amounts lime-sulfur to make 50 gals. of spray for summer sprays on apples. Should test 1 degree Baume.
Specific Gravity	Baume Degrees		
1.318	35	5 gal. 1 qt.	1 gal. 1 pt.
1.283	32	6 gal.	1 gal. 1 qt. ½ pt.
1.261	30	6 gal. 3 qt.	1 gal. 1 qt. 1½ pt.
1.239	28	7 gal. 1 qt.	1 gal. 2 qt. ½ pt.
1.218	26	8 gal. 1 qt.	1 gal. 3 qt.
1.198	24	9 gal. 1 qt.	2 gal.
1.179	22	10 gal. 2 qt.	2 gal. 1 qt.
1.160	20	12 gal.	2 gal. 2 qt. 1 pt.
1.142	18	13 gal. 3 qt.	3 gal.
1.124	16	15 gal. 2 qt.	3 gal. 1 qt. 1 pt.

Preserve This Table

SPECIAL EMERGENCY CONTROL MEASURES FOR CODLING MOTH.

Some of our best commercial growers had from 60 to 85 per cent worms and stings in 1926, in spite of a regular spray schedule such as has been used successfully for 10 years or more. Weather conditions may have had their influence, but it is the opinion of some entomologists that a strain of codling moth more resistant to arsenical poison may have developed.

Whatever the cause may be, the better growers are now supplementing their spraying with a general clean up of the orchard. Orchard picking and storage crates and baskets furnish excellent over-winter quarters for the worms. These hibernating larvae are easily killed by a 3-minute bath in a kettle of boiling water. In one bushel basket examined in 1926, 160 codling moth larvae were found hiding between the staves. The scraping and burning of the loose bark of the tree trunk and large branches, in winter, kills many of the hibernating larvae. This treatment is followed by banding the trunk of the tree with burlap bags or building paper, cut in strips 5 or 6 inches wide (see figure 7), placed around the trunk of the tree and fastened with two small nails. This band serves as a trap to catch the codling moth larvae.

Leave the bands in place thruout the year. When the larvae of the first brood are leaving the apples (June 15th to August 1st), the bands should be examined at 10-day intervals and all larvae killed. During September and October, as the mature larvae are leaving the fruit and seeking places to hibernate, a large number are likely to use the bands as hiding places. The bands are examined again during the winter or early spring to kill the larvae present. The banding operation is of considerable importance in reducing the codling moth injury, and the expense is small.

Fig. 7. Apple tree "banded" with a 6-inch band of building paper to collect codling moth larvae. Note that the trunk and branches have had the rough, scaly bark removed to destroy the natural hiding place of the larvae.